

**FOCUSABLE AND STEERABLE
MICRO-MINIATURE X-RAY APPARATUS**

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ABSTRACT OF THE DISCLOSURE

A micro-miniature x-ray apparatus comprises: a first chip subassembly including a source of x-rays including both Bremsstrahlung photons and characteristic x-rays; a second chip subassembly including a filter for transmitting the characteristic x-rays and blocking the Bremsstrahlung photons; a third chip subassembly including a movable element for focusing or collimating the transmitted characteristic x-rays into a beam and means for controlling the position of the focusing element. In one embodiment, the controlling means include a micro-electromechanical system (MEMS). In another embodiment, the position of the movable element determines how the x-ray beam is steered to the focal area. In still another embodiment, the x-ray source includes a field emitter electron source and a target responsive to the electrons for generating x-rays. In this case, the x-ray beam is also steered by selectively energizing the anode segments. In yet another embodiment, the movable element includes a Fresnel zone plate; in still another embodiment it includes an array of poly-capillaries.

Advantageously, our x-ray source, including its focusing, collimating and steering components, can be fabricated small enough to be mounted at the end of a catheter. In addition, in some embodiments it can also be fabricated sufficiently inexpensively to be disposable after each use.